



Centrella® Smart+ Bed:

CONTACT-FREE, CONTINUOUS MONITORING

Powered by EarlySense

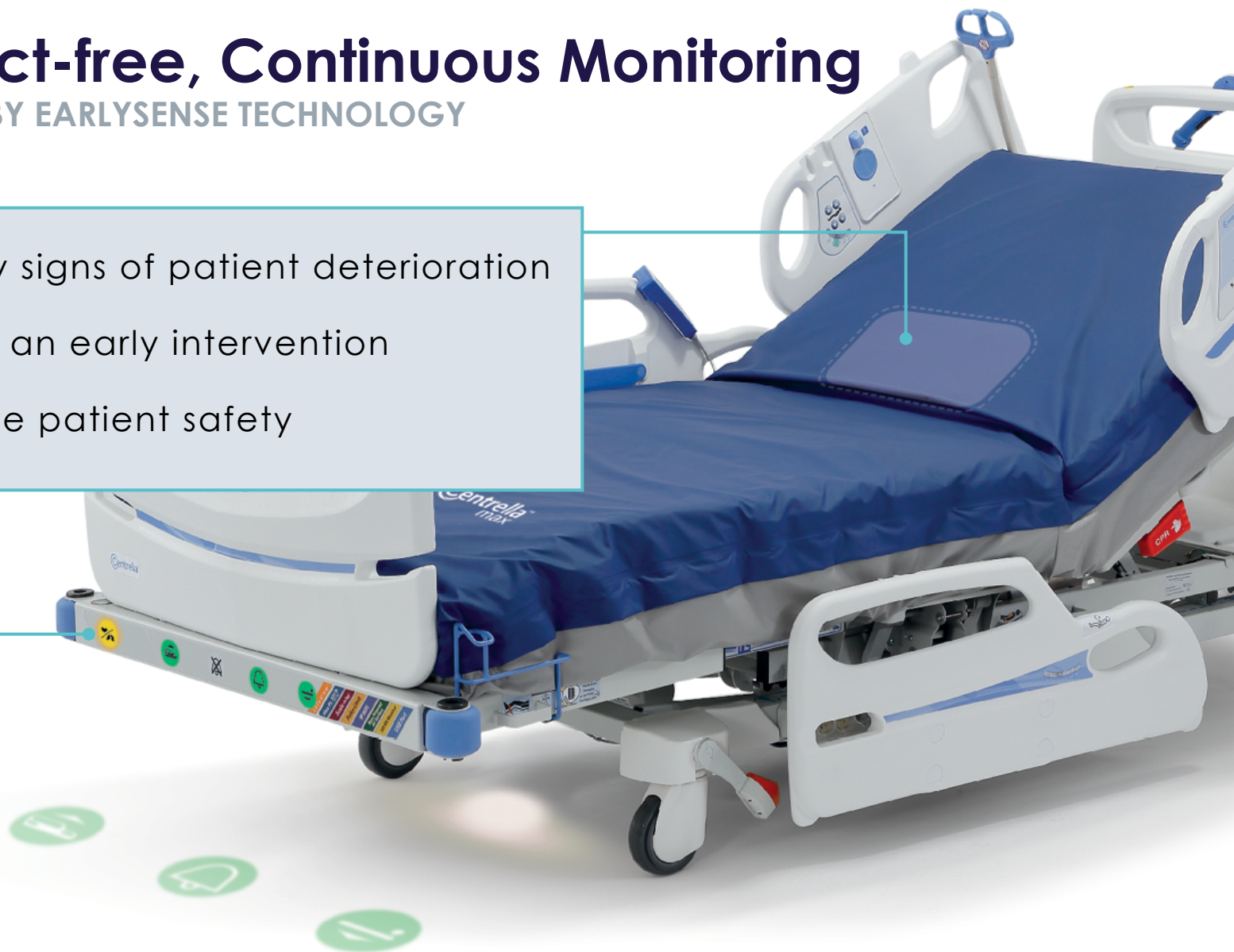


Hillrom™

Contact-free, Continuous Monitoring

POWERED BY EARLYSENSE TECHNOLOGY

- ✓ Identify signs of patient deterioration
- ✓ Initiate an early intervention
- ✓ Promote patient safety



Promoting a Culture of Patient Safety



These organizations and others like them have recognized a simple fact:

TOO MANY PATIENTS ARE DYING FROM PREVENTABLE CAUSES.

2019 Top 10 Patient Safety Concerns¹



1. Diagnostic Stewardship and Test Result Management Using EHRs
2. Antimicrobial Stewardship in Physician Practices and Aging Services
3. Burnout and Its Impact on Patient Safety
4. Patient Safety Concerns Involving Mobile Health
5. Reducing Discomfort with Behavioral Health
6. Detecting Changes in a Patient's Condition
7. Developing and Maintaining Skills
8. Early Recognition of Sepsis Across the Continuum
9. Infections from Peripherally Inserted IV Lines
10. Standardizing Safety Efforts Across Large Health Systems

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- 6. DETECTING CHANGES IN A PATIENT'S CONDITION**
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- 8. EARLY RECOGNITION OF SEPSIS ACROSS THE CONTINUUM**
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Critical Events Drive Patient Safety Outcomes



**UNRECOGNIZED PATIENT DETERIORATION
THAT CAN LEAD TO MORTALITY**

17%

MAY AFFECT AS MANY AS 17% OF HOSPITAL ADMISSIONS.²

Patient Deterioration

A patient moves from one clinical state to a worse clinical state.¹²

Increasing their individual risk of

MORBIDITY → PROTRACTED HOSPITAL STAY → DISABILITY → DEATH

FAILURE TO RESCUE¹³

Heart
failure

Electrolyte
abnormalities

Sepsis

Ischemia

DVT/PE

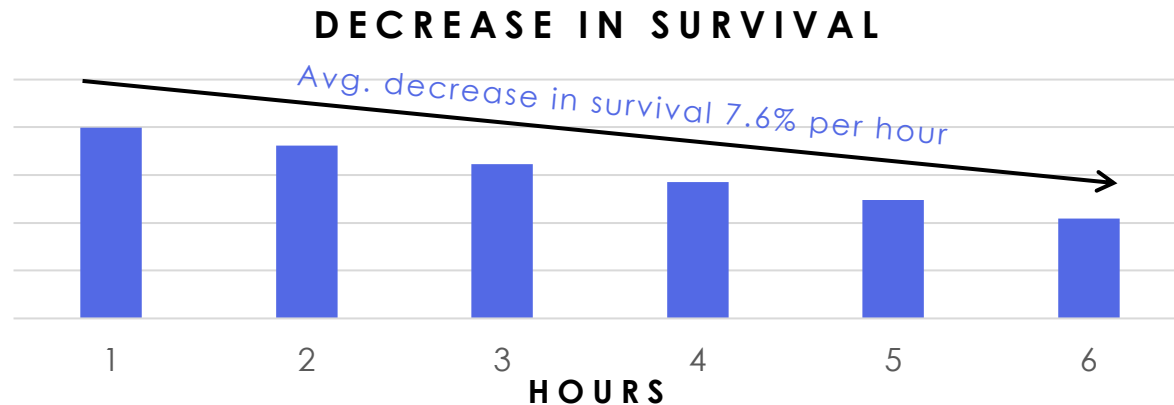
Respiratory
insufficiency

Sepsis



#1 cause of death in U.S. hospitals⁸

35% OF ALL DEATHS IN HOSPITALS⁸



- Risk can be reduced by quickly identifying and managing infections.⁸
- Mortality increases **8%** for every hour that treatment is delayed.⁸
- **\$38k**, Median hospital cost to treat Hospital Acquired Severe Sepsis.¹⁰

Opioid Induced Respiratory Depression



57%

of medical patients were prescribed opioids, sedatives, or both.³

1/3

of Code Blue arrests are from respiratory depression.⁴

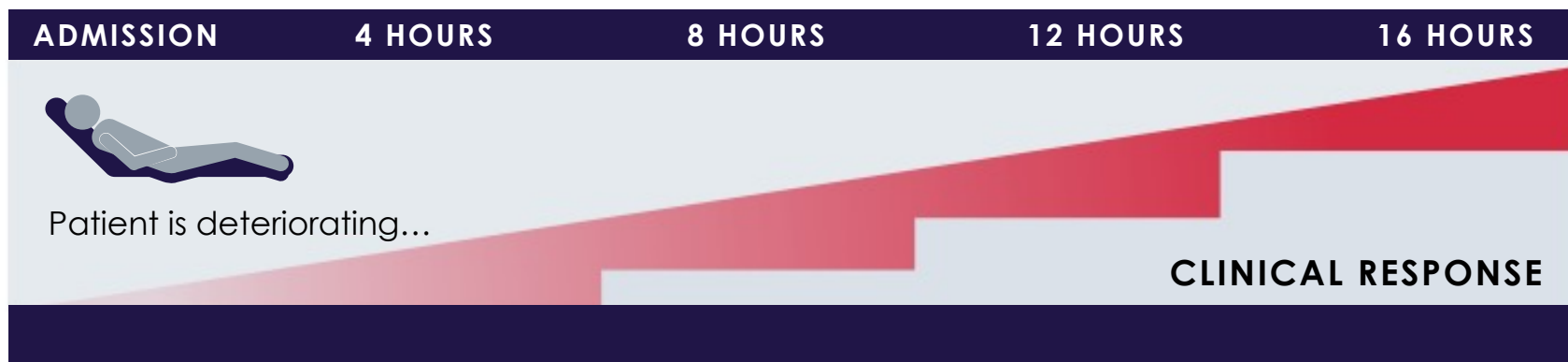
\$27k

increased treatment cost for opioid patient that suffers arrest.⁵

7.57 DAYS

increased length of stay of opioid patient suffering arrest.⁵

Patient Deterioration



6-8

POTENTIAL HOURS OF WARNING SIGNS PRIOR TO EVENT.²

The Med-Surg Environment is Challenging



INCREASING
PATIENTS,
ACUITY AND
COMPLEXITY

STAGNANT
TECHNOLOGY
& INNOVATIONS

COST
CONSTRAINTS

HIGH PATIENT-
TO-NURSE
RATIOS

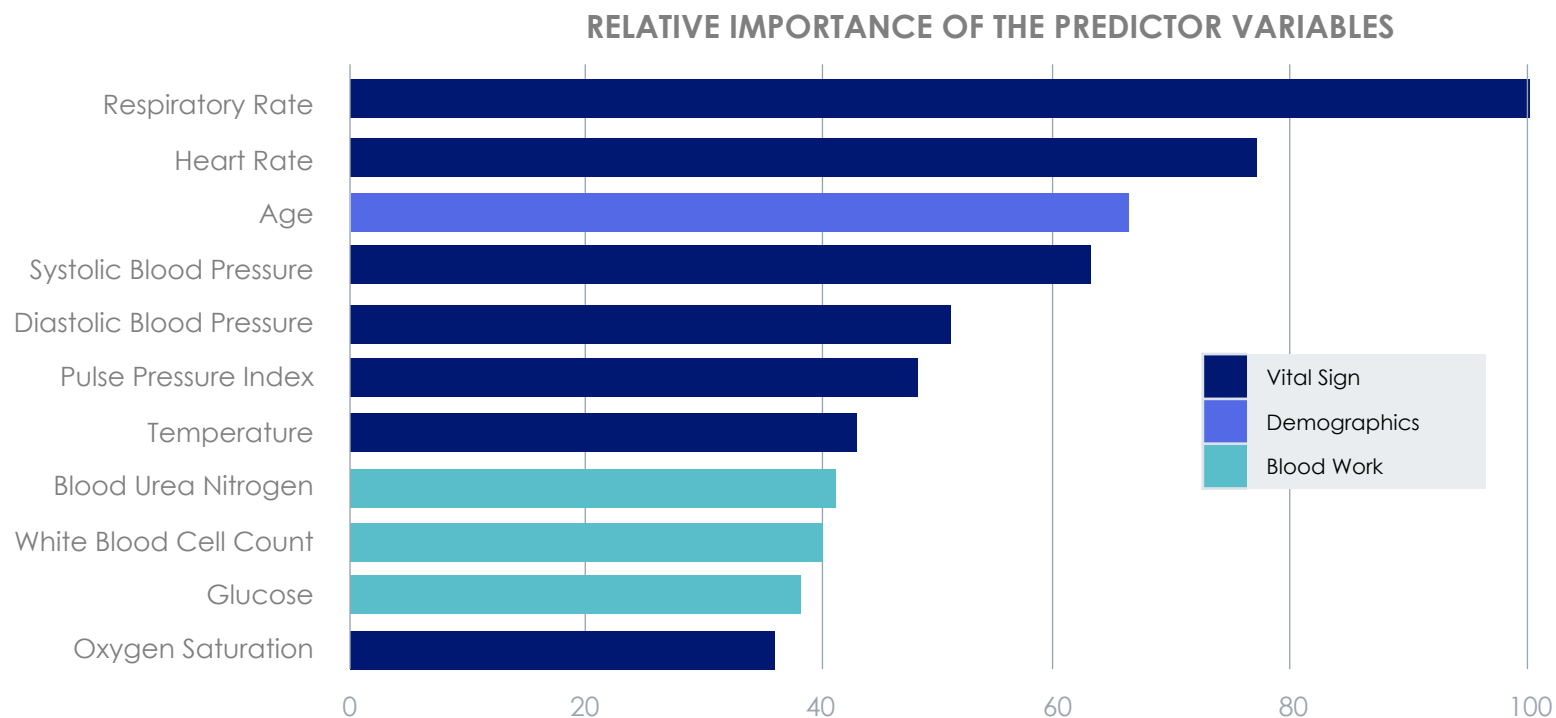
STAFF
TURNOVER,
RETENTION
AND TRAINING



HillromTM

Leading Indicators of Deterioration

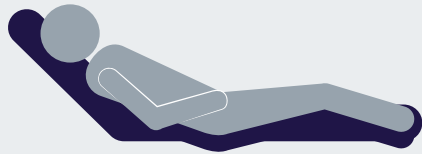
Respiratory rate and heart rate are the most important predictor variable of deterioration.⁶



Two Paths of Patient Deterioration

RECOGNIZED

RN Intervention • MD Intervention • Rapid Response



**PATIENT
DETERIORATION**

UNRECOGNIZED

Code Blue • ICU Transfer/Readmit • Mortality

CONTRIBUTING CONDITIONS

A Real-Life Impact:⁹ *Opioid Induced Respiratory Failure*



John LaChance

- Rotator Cuff surgical patient
- Diagnosed with sleep apnea

Thursday, March 15, 2007

John underwent his second routine rotator cuff repair surgery.

10 AM

12 PM

2 PM

During the afternoon, John began to deteriorate. Symptoms included fever and extreme vomiting.

5 PM

Within a half hour, John was comatose and never spoke again.

5:30 PM

5:30 AM

Immediately following surgery, John was doing well. His pain was managed with a shoulder block and Morphine through a PCA pump.

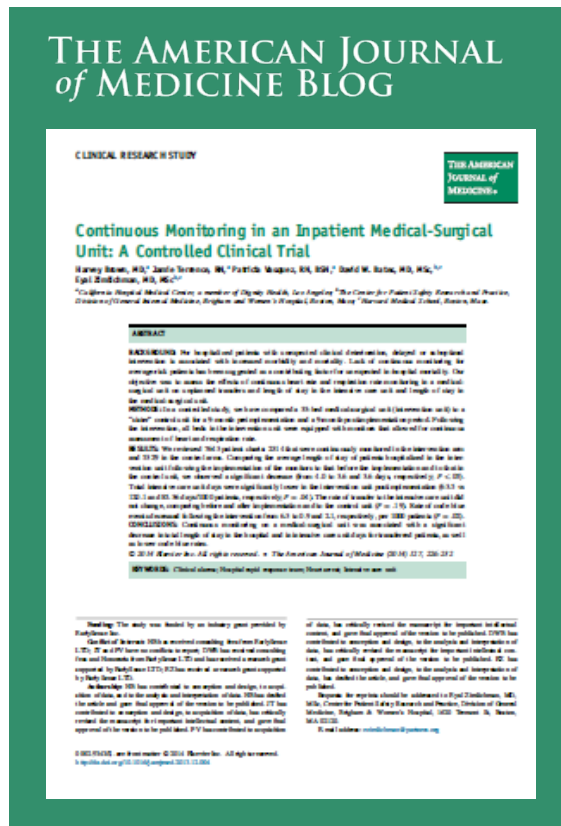
By the early evening, his shoulder block had worn off. John was taken off Morphine and prescribed a high dose of Dilaudid.

**Friday,
March 16, 2007**

By 5:30am, John was dead.

Continuous Monitoring in an Inpatient Medical-Surgical Unit: A Controlled Clinical Trial

Harvey Brown, MD⁷



↓
86%
CODE BLUE
EVENTS

↓
47%
ICU PATIENT
TRANSFERS

↓
9%
MED-SURG
LOS

“Results may support the hypothesis that continuous monitoring leads to earlier recognition of patient deterioration.”

Identifying Patient Deterioration Early Using Contact-Free, Continuous Monitoring on and Inpatient Medical – Surgical Unit

Annot Health, accepted to be presented at the Institute for Healthcare Improvement Conference, December 2019

POSTER HIGHLIGHTS

- 26-bed inpatient medical-surgical unit
- 7 cases in which contact-free continuous monitoring was used to **identify patient deterioration** and **intervene earlier**

CASE TYPES

- Airway management
- Alcohol withdrawal management
- Opioid Induced Respiratory Depression
- Pain management
- Oxygen management

"Use of the technology helped drive interventions including airway management and medication optimization for appropriate treatment and avoidance of respiratory depression."



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Identifying Patient Deterioration Early Using Contact-Free Continuous Monitoring on an Inpatient Medical-Surgical Unit

Authors: Jan Linderberry MSM, RN and Shelley Derr BSN, RN

DESCRIPTION

Up to 17% of inpatient admissions experience clinical deterioration.¹ Warning signs can often be identified 6 to 8 hours before deterioration events occur.² Early warning scores are used to identify high risk patients, but are not intended to identify deterioration in real time.³ Respiratory and heart rate are the most accurate vital sign deterioration predictors, and accuracy is improved with trending of those vital signs.⁴ Studies have shown contact-free continuous monitoring of respiratory and heart rate on a medical-surgical unit decreases length of stay, ICU length of stay, and code blue rate.⁵

AIM

Implement contact-free continuous monitoring to identify patient deterioration early on a medical-surgical unit.

ACTIONS TAKEN

Contact-free continuous monitoring technology was implemented on a 26-bed inpatient medical-surgical unit at Annot Ogden Medical Center. In addition to providing alerts at customizable upper and lower limits of both respiratory and heart rate, clinicians were able to view trend data for both vital signs.



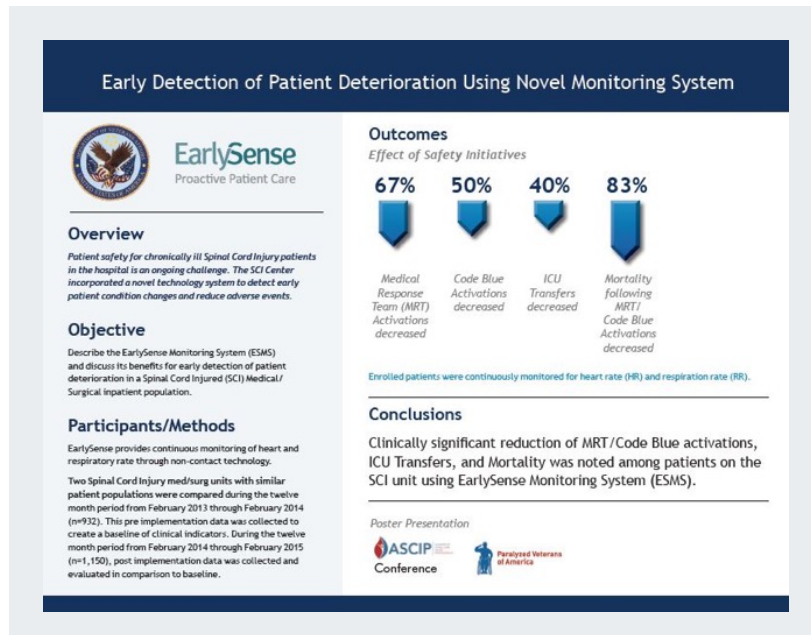
REFERENCES

1. Ben-ari J, Zimlichman E, Adl N, Sorkine P. Contactless respiratory and heart rate monitoring: validation of an innovative tool. J Med Eng Technol. 2010;34(7):839-8.
2. Brown H, Terrence J, Vasquez P, Bates DW, Zimlichman E. Continuous monitoring in an inpatient medical-surgical unit: a controlled clinical trial. Am J Med. 2014;127(3):226-32.
3. Prytherch DR, Smith GB, Schmidt PE, Featherstone PL. VIEWS—towards a national early warning score for detecting adult inpatient deterioration. Resuscitation. 2010;81(8):932-7.
4. Churpek MM, Adhikari R, Edelson DP. The value of vital sign trends for detecting clinical deterioration on the wards. Resuscitation. 2016;102:1-5.

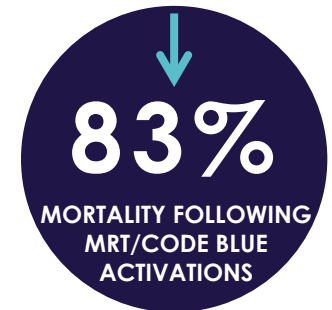
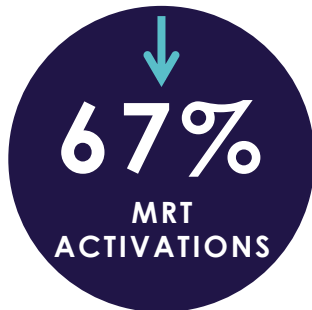
Acknowledgments: This study was supported by Heart Rate & Respiratory Rate Monitoring on Critical Care Units—Bed 100 Item, Inc.

CASE TYPE	DEMOGRAPHICS	ADMITTING DIAGNOSIS	RELEVANT HISTORY	CFCM FINDING/ALERT	INTERVENTION/OUTCOME
Airway Management	51-year-old female	Cervical disc, herniation, stenosis	<ul style="list-style-type: none"> • s/p anterior cervical fusion • esophageal swelling 	RR 42	<ul style="list-style-type: none"> • Contact free continuous monitoring on the bed indicated a high respiratory rate of 42 which triggered the alarm • Brought staff to the bedside and found patient choking but not completely obstructed • Bed showed a onetime burst of elevated respiratory rate due to the patient choking • Ensured patient's airway was patent • Gave patient emotional support – patient expressed relief when staff came in • Prevented patient from hurting herself (she was starting to try to get out of bed) and ensured patient airway
Alcohol Withdrawal Management	22-year-old male	Ethanol withdrawal, Delirium tremens	<ul style="list-style-type: none"> • Receiving lorazepam for DTs 	HR trending up	<ul style="list-style-type: none"> • Increased lorazepam dose • HR stabilized
Opioid Induced Respiratory Depression	79-year-old male	Total right knee arthroplasty	<ul style="list-style-type: none"> • Patient recovering from surgery / anesthesia • Asthma • Periods of apnea 	RR 7	<ul style="list-style-type: none"> • Patient evaluated for sleep apnea • Patient evaluated for naloxone treatment
Opioid Induced Respiratory Depression	69-year-old female	Upper abdominal pain s/p colectomy	<ul style="list-style-type: none"> • Colectomy for ileocecal adenocarcinoma 1.5 months ago • Guillain-Barre syndrome with residual bilateral leg weakness • Chronic back pain 	RR 8	<ul style="list-style-type: none"> • Patient evaluated for naloxone treatment • Given oxygen • Physician notified
End of Life Care – Pain Management	88-year-old female	Acute pancreatitis	<ul style="list-style-type: none"> • Non-responsive on comfort care 	<ul style="list-style-type: none"> • RR 35 alert • HR/RR both trending up 	<ul style="list-style-type: none"> • Based on trends and physical exam, patient determined to be in pain • Patient given IV hydromorphone and sublingual atropine • Vitals stabilized • Based on trends and physical exam, pain level improved

Early Detection of Patient Deterioration Using a Novel Monitoring System¹¹



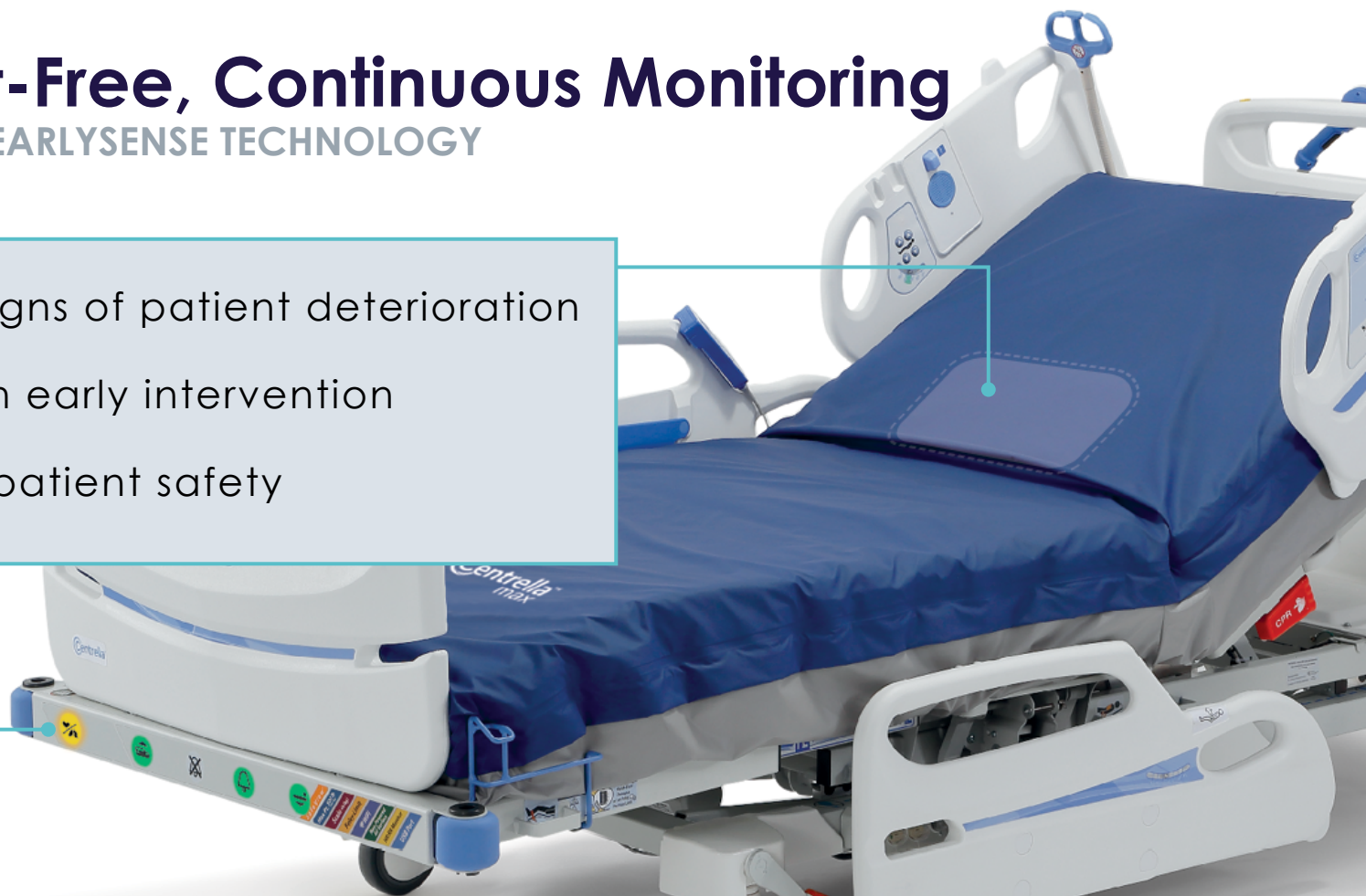
Clinically significant reduction of MRT/Code Blue activations, ICU Transfers, and Mortality was noted.



Contact-Free, Continuous Monitoring

POWERED BY EARLYSENSE TECHNOLOGY

- ✓ Identify signs of patient deterioration
- ✓ Initiate an early intervention
- ✓ Promote patient safety



THE PROVEN PERFORMANCE AND ACCURACY OF EARLYSENSE MONITORING IS NOW EMBEDDED INTO THE CENTRELLA® SMART+ BED.

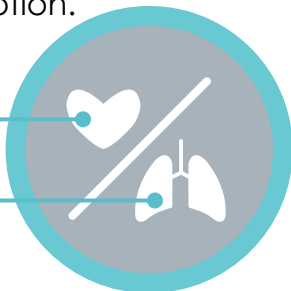


Hillrom™

Contact-Free, Continuous Monitoring

HOW DOES IT WORK?

When your heart beats
it creates motion.



When you breathe, your lungs expand and contract, creating motion.

The sensor detects cardiac and respiratory motion through the mattress.



The sensor is able to update the HR/RR values twice per second.

All of this information is compiled in an algorithm:

- Creates a running trend of HR/RR
- Filters out other constant motion like an air surface



User Interface Screens



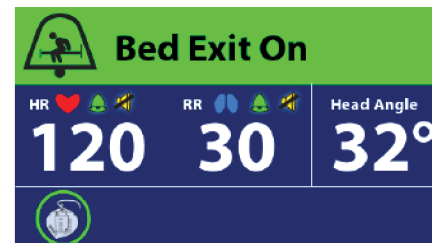
HOME SCREEN



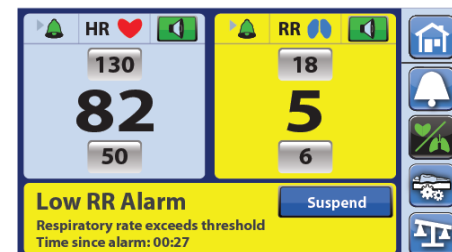
HR/RR MONITORING



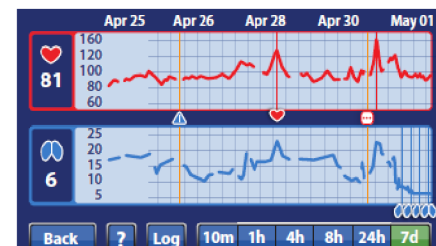
SLEEP SCREEN



ALERT SCREEN



7-DAY TREND



Heart Rate and Respiratory Rate Alerts

When HR/RR exceeds one of the set thresholds, the bed will alert:

VIA LOCAL ALERTS



SafeView®+ Light



Bed Touchscreen Alerts
(turns yellow)

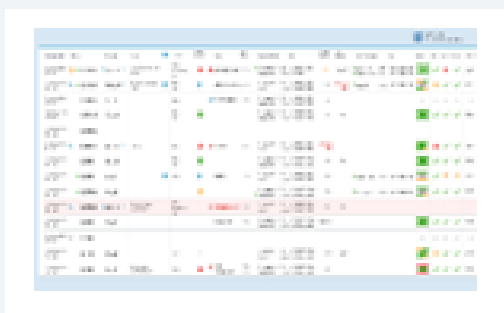


Audible Alert

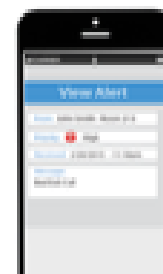
AND THROUGH NAVICARE® NURSE CALL



Dome Lights



Status Board



Mobile Device Alerts

SafeView®+ Indicators

SafeView®+ indicator is **WHITE**

- There is no patient in the bed.
- Patient HR/RR can not be read.



SafeView®+ indicator is **GREEN**

- Bed senses patient weight.
- HR/RR is being monitored in safe range.



SafeView®+ indicator is **FLASHING AMBER**

- HR/RR threshold is passed.
- Light turns solid Amber once alarm is silenced.





To learn more about
heart rate and respiratory
rate monitoring please visit:

CENTRELLABED.COM

**CENTRELLA®
SMART+ BED:
THE BED
IS JUST THE
BEGINNING.**



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References

1. ECRI Institute. 2019 Top 10 Patient Safety Concerns.
2. Ben-Ari, et al. Contactless respiratory and heart rate monitoring: validation of an innovative tool. J of Med Eng & Tech, Vol. 34, Nos 7-8, Oct-Nov 2010, 393-398.
3. Izrailtyan I, Qiu J, Overdyk F, Erlson M, Gan T. Risk factors for cardiopulmonary and respiratory arrest in medical and surgical hospital patients on opioid analgesics and sedatives.
4. Opioid Safety & Patient Monitoring. The National Coalition to Promote Continuous Monitoring of Patients on Opioids. Nov 2014.
5. Overdyk F, et al. Association of Opioids and Sedatives with Increased Risk of In-Hospital Cardiopulmonary Arrest from an Administrative Database. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4767404/>
6. Churpek MM, Adhikari R, Edelson DP. The value of vital sign trends for detecting clinical deterioration on the wards. Resuscitation. 2016;102:1-5.
7. Brown HV, et al. The American Journal of Medicine. 2014; 127:226-232.
8. Sepsis Alliance. Sepsis.org. Sepsis Fact Sheet.
9. Patient Safety Movement; Patient Stories; <https://patientsafetymovement.org/advocacy/patients-and-families/patient-stories/john-lachance/>.
10. Page D MD, et al. Community-, Healthcare- and Hospital-Acquired Severe Sepsis Hospitalizations in the University HealthSystem Consortium. Crit Care Med. 2015 Sept; 43(9): 1945-1951.
11. Early Detection of Patient Deterioration Using Novel Monitoring System. VA Poster. ASCIP Conference.
12. Jones D, et al. Defining clinical deterioration. 2013.
13. Edelson D MD MS FAHA. Agile MD-Hill-Rom Collaboration. Dec 2018.

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